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ABSTRACT

Application of Computer-based systems to Training in Information Technology (ACT-IT, a project by a consortium of partners in the United Kingdom and the Irish Republic, is part of the TIDE program, an initiative of the European Community (EC) to make information technology more accessible to disabled and elderly people. This paper outlines the work of the ACT-IT project and highlights certain aspects of it. The project aims to help intellectually impaired or elderly people use information technology at work and in everyday situations. The objective has been to facilitate the learning of those skills which are needed in order to interact effectively with information technology. The project has created a prototype multimedia learning environment which takes into account the needs of intellectually impaired people and assists potential courseware authors in creating multimedia courses for such users. A model of intellectual impairment has been produced which analyzes the needs of the target learner-users. Also a taxonomy of information technology situations and a model of access needs are provided which analyze those skills needed to cope with information technology in the variety of situations that arise in everyday life and employment. Two prototype pieces of courseware have been produced using the multimedia courseware production environment. The first deals with the task of obtaining cash from an automated teller machine. In the second, the learner-user is taught how to find a book in the library using a computer-based catalog. Thirteen teaching utilities were identified and used in the ACT-IT PROJECT: attention-grabber; personal tutor; application context; peer group modeling; simulation; action replay; notebook; assessment; reward; analog task map; choice; tea break; and personal assistant. (MAS)

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Multimedia Training Systems for the Elderly and the Impaired

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Abstract: The paper describes work recently completed on a European Project which has aimed to use multimedia to help intellectually impaired or elderly people to learn to use Information Technology (IT) at work and in everyday life situations. The objective has been to facilitate the learning of those skills which are needed in order to interact effectively with IT. The target learners are those who, because of their special needs, might otherwise be barred from gaining access to services and potential employment involving the use of IT.

The project described in this paper has created a prototype multimedia learning environment which takes account of the needs of intellectually impaired people and assists potential courseware authors in creating multimedia courses for such users. A model of intellectual impairment has been produced which analyses the needs of the target learner-users. Also a taxonomy of IT situations and a model of access needs are provided which analyse those skills needed to cope with Information Technology in the variety of situations that arise in everyday life and employment. Two prototype pieces of courseware have been produced using the multimedia courseware production environment. The first deals with the task of obtaining cash from an Automated Teller Machine. In the second, the learner-user is taught how to find a book in a library using a computer-based catalogue.

A distinguishing feature of the project is the provision, not simply of a multimedia authoring system, but of a predefined pedagogic model of the system and the provision of support for the author-user in the form of guidance in instructional strategies. In particular 13 "teaching utilities" are identified and these will be discussed in the present paper. In the prototype, these utilities are exemplified as a set of reusable multimedia modules from which a courseware designer is free to select during the creation of a teaching-learning package. The prototype courseware runs under DOS and Windows 3.1 on a 386 or 486 IBM-compatible machine with a touch screen and a video card linked to a laserdisc player.

1. Introduction

It is estimated that, because of improved living conditions and better health care, by the year 2020 there will be between 60 and 80 million citizens in the European Community. One in four of us will be over 60. Disability is associated with increasing age and 70% of the disabled are over 60. Access to Information Technology can help this category of people live independent lives.

The TIDE programme is an initiative of the European Community (EC) to make Information Technology more accessible to disabled and elderly people. Proposals were invited under this scheme from consortia based within the EC with the proviso that at least two European Community countries must be represented. One such contract was won by a consortium involving partners in the UK and the Irish Republic. The project was known as ACT-IT: Application of Computer based systems to Training in IT. The partners were London Guildhall University (formerly City of London Polytechnic) and Interactive Multimedia Systems, Dublin, with sub contracting partners (See acknowledgements).

This paper outlines the work of the ACT-IT project and highlights certain aspects of it. A fundamental aim of the ACT-IT project has been to facilitate access to Information Technology systems by users who by virtue of their special needs, their background or their environment are in some way inhibited from using such systems.

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We are all aware of typical reactions to IT devices in which, for example, a 10 year old boy will quickly jump in and feel at home operating a new system (say, a programmable video recorder or home computer) while his 65 year old grandparent has an inertia, perhaps even a fear, which inhibits involvement. Moreover, a sizeable proportion of the population has some special need based on physical or mental impairment which prevents them accessing Information Technology effectively. The physical impairment of being wheel-chair bound may prevent certain users reaching up high enough to access some cash dispensing machines. Intellectual impairment may reduce the capacity of some users to understand and use such devices successfully. There are many people in the lower mental ability ranges who can be helped in their everyday lives and in their potential employment opportunities if they can learn to use IT systems effectively.

2. Support for the Multimedia Courseware Author

In the introduction we have briefly described the target courseware user, but what of the courseware author? Many demands are placed on courseware authors and some of these have been identified by Inwood (1992):

* A detailed knowledge of the domain to be taught
* A knowledge of the group of learners and their needs
* A teaching strategy
* A knowledge of interface design
* A teaching style, and aesthetic and creative abilities.

The ACT-IT project assists the author in all of these areas. It provides resource management aids and gives on-line advice in areas where the author's skills may be deficient. This support is sometimes paper based, but powerful computer based tools and methods are supplied. The advice is based on the model of impairment and of the capabilities of the target user.

In particular a teaching strategy is available for the author to use. A delicate balance is maintained throughout so that the author's creativity is respected and not stifled; on the other hand help and advice is available on demand. Indeed sometimes it will appear on the screen spontaneously.

2.1 The Taxonomy of IT Situations

It may generally be assumed that courseware authors are familiar with the subject area on which they are seeking to create a course. However they may be multimedia specialists and not subject specialists. Moreover they may not be aware of the potential for reusability inherent in individual elements of the courseware they are creating. The ACT-IT system therefore provides a taxonomy of IT-situations and a model of access needs which analyses the skills needed for various IT-related activities. One courseware module may be used in teaching about several IT devices and one environment (eg a library) may require the teaching of many devices.

2.2 The Model of Access Needs and the Model of Impairment

There has been strong psychological theoretic input into the ACT-IT project. The needs of learners seeking to master a wide variety of IT tasks is analysed. This covers reading age and IQ levels required in relation to the overall load on the learner.

Potential trouble spots in teaching situations are identified where excessive loads may be placed on learners because of their particular impairment levels with regard to the following:

* Verbal comprehension
* Memory
* Arousal
* Processing Speed
* Perception
* Attention
* Perceptual Organisation
* Freedom from Distractibility
* Domain specificity

The model of access needs provides a standard load table for any part of a course which indicates, on a six point scale, what demands are placed, in each of the above areas, on a standard learner (e.g. "high"..."low"..."extremely low"). A model of impairment provides, for a particular learner, an impairment profile which will be a six point score with regard to their ability/impairment level for each of the above areas. For each of these areas ACT-IT has devised a set of guidelines to help the author and the delivery system take account of the target learner's potential intellectual strengths and weaknesses.

2.3 Pedagogic Strategies

Examples of pedagogic strategies are available from the authors. Space does not permit inclusion of an example here.

2.4 Design Support Tools

These include the teaching utilities which will be outlined in section 3 of this paper.

2.5 Courseware Production Facilities

The multimedia courseware author is provided with a WIMP interface. A palette of tools is available and authors can manipulate courseware flow templates on screen. Authors may, depending on their response to an initial enquiry about their level of experience, either start with a blank screen, with a standard design in "time line" notation or with a semi-built design (for the moderately competent). In each case authors select tools by icon and position them with the mouse.

Screen templates are supplied, based on good user-interface principles. Authors are free to create their own templates and store them in personal libraries for future use.

2.6 Prototype Courseware

As well as providing production facilities, ACT-IT has provided two demonstration courseware packages. One aims to encourage elderly and impaired bank customers to use cash dispensing machines. The other illustrates how the author can create a course using a set of multimedia building blocks provided. The course is concerned with encouraging library users to use the LIBERTAS computer-based catalogue system to obtain library services. The target user group is the same as described before, namely the impaired and elderly. This prototype illustrates how the author may make selections concerning the use of the teaching utilities discussed in the following section.

3. Teaching Utilities

It is not possible here to give more than a brief introduction to all the work that has been done by the project on the 13 teaching utilities which it has identified. Within the ACT-IT deliverables, there is provided, for each teaching utility, a formal definition, a list of guidelines to aid the course author in the use of that teaching utility and the development of media sequences for use with it, and an indication of the kind of control of the utility that the user should be given. The basis for each teaching utility in research and practice is also provided.

In the rest of this section, space only permits a few comments on each teaching utility. A few samples only are provided of references to the literature. For a full discussion, reference should be made to the ACT-IT project final report.

3.1 Attention-grabber

Every good lecture, sermon, TV programme or film must begin with something that grabs the attention of listeners or viewers. Such audiences are always free to walk out or switch off but at least they are in some sense initially 'captive'. In the multimedia context addressed by ACT-IT, the potential user's interest must first be captured: the system may be running in a public place such as a library or bank lobby. Users passing

by may not have come with the intention of using the system. So, the purpose of the attention-grabber is to capture attention and encourage potential users to interact with the technology.

Courseware authors should be provided with a library of multimedia attention-grabbers for possible use. Typical examples would include exploding fireworks on screen accompanied by suitable rousing music.

3.2 Personal Tutor

Given the resistance that our target users may have to educational technology, this teaching utility offers them the choice of a human face to guide them throughout the courseware. Such surrogate tutors will talk to the user in a normal human way. They will typically appear on screen at the beginning, giving a welcome. They will help to motivate the learner and introduce the course structure. They may appear later in small windows, or by voice with still images only, to introduce segments of the course, or to provide help where needed.

Ideally the learners should be able to choose their personal tutor from a selection representing different age-groups, races, sexes and cultures.

3.3 Application Context

This provides the learner with motivation for learning a particular skill by showing a situation in which it is desirable to possess it. For example, one might display a long queue at a railway station ticket office with an automatic ticket machine not being used as a train arrives. (British Rail have recently introduced on the spot fines for boarding a train without a ticket, a queue at the booking office being no excuse!)

This teaching utility sets the scene for the target learner and should be made to relate to his or her culture and experience. It is essential that learners find personal meaning and relevance as they experience multimedia courseware. Emotional and motivational appeal is greatly increased when video and sound are used, according to Ambron (1990).

3.4 Peer Group Modelling

The purpose of this utility is to encourage learners to feel more confident by showing members of their peer group succeeding in using an IT-system. These role modelling situations encourage learners to learn by imitating the successes of others and avoiding their mistakes.

As mentioned in 3.3 above, audio-video sequences are recommended but if storage capacity is limited, sequences of still images may be used for this teaching utility.

3.5 Simulation

The simulation is a well established component of technology based education and training. The learner has the benefit of rehearsing actions in an environment that is safe and non-threatening from the point of view of health and safety and also data security.

Users of simulations can acquire skills in domains where the real-life situation would require large amounts of time and or money to set up. Moreover users may learn by making errors in isolation from their real consequences, before using the actual IT device.

3.6 Action Replay

The facility for the learner to replay any courseware sequence should be made available by the multimedia author. This is particularly relevant after using the following teaching utilities: personal tutor, peer group modelling, application context and simulation. Further, the user should be allowed to freeze and unfreeze any part of a sequence as it is replayed.

Repetition is generally regarded as highly important in imparting both declarative and procedural knowledge. Case *et al* . (1986) have emphasised the necessity of recapitulation in remedial teaching. The acquisition of motor skills, for example those required to operate a mouse or Concept Keyboard, makes heavy demands on repetition.

3.7 Notebook

Note taking in lectures has been a traditional component of learning for generations of students. The multimedia environment extends this idea. This teaching utility provides another opportunity for placing the learner in control. The user can define any multimedia item (e.g. a clip of video or a piece of text or music) and store it, with or without personal annotations, in his or her own multimedia notebook. To review the notebook later will obviously be valuable.

Cognitive research into note taking (for example by Suritsky & Hughes (1991) and Bretzing *et al* . (1987) has indicated that taking and reviewing personal notes leads to better retention of material.

3.8 Assessment

Every course needs a method of assessment and multimedia packages are no exception. Computers have been widely used for assessment and so much has been written that the subject can hardly be opened in this short paper. Suffice it to say that the mundane kind of drill and practice activities that characterised early work on CAL should be avoided. Multimedia opportunities should be exploited carefully with due regard to good human factors practice. Sensitivity should be exercised with regard to setting targets for individual users with special needs.

3.9 Reward

An important element of feedback to the learner is some form of reward which acknowledges and reinforces correct responses, effort and improvement.

Use of the Personal Tutor teaching utility is particularly appropriate for delivering rewards. The learner's personally chosen tutor can appear from time to time to give encouragement, either by means of a video clip in a window or by voice only (possibly accompanied by a still image in a window).

Just as the personal tutor is chosen by the learner, so too should be the form of reward. This will depend on the age and ability or impairment level of the learner.

Words of encouragement may be delivered verbally or textually or a points system (preferably animated in some way) should be used. A cartoon figure could replace the human personal tutor. Ideally rewards should be presented in a variety of forms which take account of the learner's impairment; they should never be patronising.

3.10 Analogue Task Map

This teaching utility tells the learner where they are in relation to the course as a whole. It also provides a navigation facility: "Where have I been?" "What have I covered?" "What shall I do next?"

The map could be in the form of a hierarchy diagram of the course, highlighting the units accomplished. In a simple case it might simply be in the form of a thermometer-type linear indicator.

As with all teaching utilities the author has the choice of what forms of the utility to offer the learner or indeed whether to offer the facility at all. In this case, the learner may be provided with the option of opening and closing a map-window at any stage in the course by clicking on a relevant icon.

3.11 Choice

Fundamental to any learner-centred courseware is the concept of user choice. This teaching utility provides the learner with the opportunity to make selections.

Important choices to be offered to the learner include those concerning control over the human-computer interface. Such choices, offered at the beginning of a course would include choice of personal tutor.

Other choices relate to choice of route through the course. Clearly this teaching utility will be used in conjunction with others such as assessment and the analogue task map.

3.12 Tea Break

In industrial relations, it has long been recognised by management as well as trade unions, that greater productivity is achieved if workers are kept happy, comfortable and refreshed by periodic tea-breaks. This teaching utility provides an interlude within a teaching-learning situation so that the learner may enjoy mental refreshment by doing something completely different for a while. Overall performance over a long period will be improved if regular breaks are taken. The frequency and length of the tea-breaks should be carefully controlled by the author.

3.13 Personal Assistant

As with the Personal Tutor, the learner should be presented, at the beginning of the course, with a choice of Personal Assistant. This may take the form of a person (age, sex and race of the user's choice) or a cartoon character or robot. Certain tasks within a course may be too repetitive, tedious, difficult or time-consuming for the learner to carry out. Frustration or anxiety on the learner's part may be alleviated if the author allows delegation to the personal assistant under controlled conditions.

4. Conclusion

It has only been possible in this short paper to outline some of the main features of the ACT-IT project and to spend a little longer on one aspect, namely the teaching utilities. Justice has hardly been done to the project; the written documentation of which, alone, runs to several volumes. It is hoped that further papers and books, based on the ACT-IT approach to multimedia training, will appear soon.

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